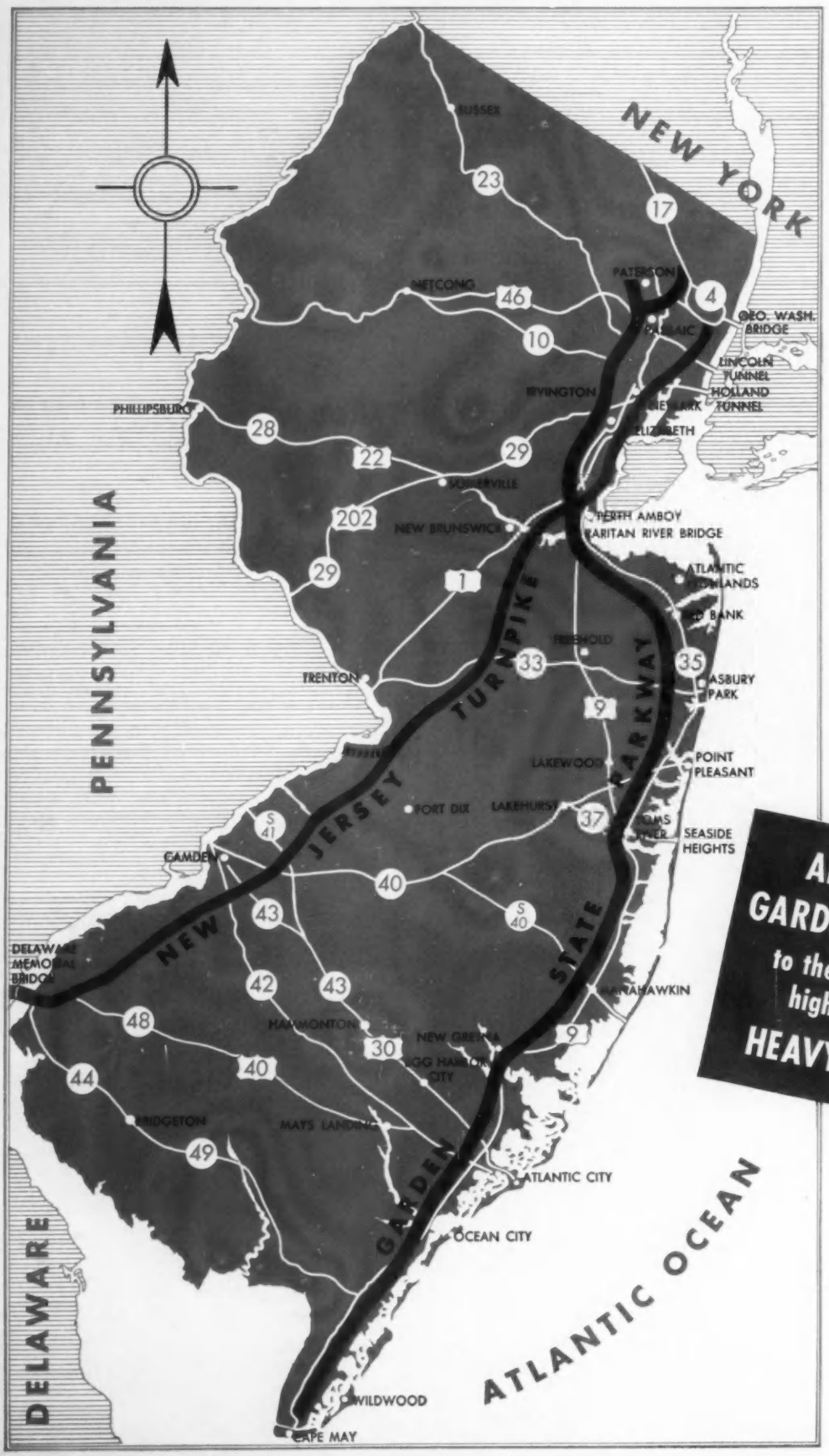
Asphalt Institute Quarterly

JANUARY, 1955



ADD NEW JERSEY'S GARDEN STATE PARKWAY

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HEAVY-DUTY ASPHALT

ANNOUNCEMENT

Effective January 1, 1955, the Headquarters (Executive Offices and Laboratories) of the Asphalt Institute, formerly located at 801 Second Avenue, New York 17, N. Y., is established at the following address:-

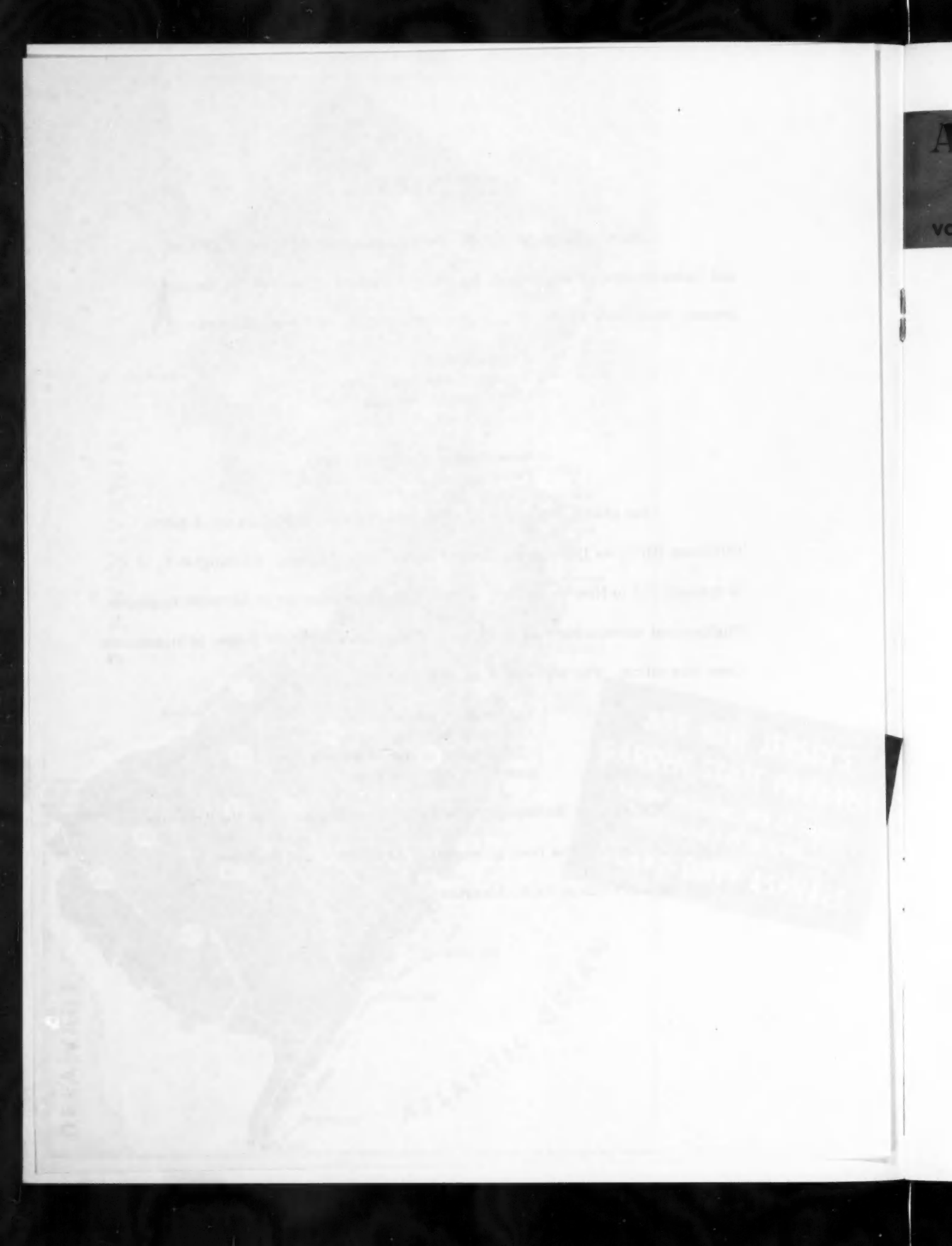
The Asphalt Institute
Asphalt Institute Building
University of Maryland
College Park, Maryland

Telephone:- WArfield 7-0422
(Washington, D.C. Exchange)

Also effective January 1, 1955, the Division Office for the Atlantic-Gulf area (Division I) formerly located in the Mills Building, Washington 6, D.C., is transferred to New York City, with Mr. Herbert Spencer as Division Engineer. Engineering service for New York City, Long Island and New Jersey is maintained from this office. The address is as follows:-

The Asphalt Institute
Americas Building
1270 Avenue of the Americas
New York 20, New York

Mr. George H. Dent, formerly Division Engineer for the Atlantic-Gulf area (Division I) has been promoted to Assistant Chief Engineer at Headquarters in College Park, Maryland.



ASPHALT INSTITUTE Quarterly

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The Member Companies of the Institute, who have made possible the publication of this magazine, are listed on page 15.

EDITOR

Richard C. Dresser

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COVERS

Featured on the covers is New Jersey's Garden State Parkway as seen from Telegraph Hill, south of the Raritan River. With its unique landscaping and medial zone, heavy-duty asphalt pavement and other important features, this beautiful super-highway is designed to give motorists speed, comfort and safety while driving to and from resorts along the seacoast.

Photo: Ostergaard

ASPHALTOPICS

A safety feature of the asphalt-paved Garden State Parkway and other highways is the white stripe painted along both edges of the roadway pavement. Paralleling the center stripe and supplementing it in the important function of keeping through traffic off the shoulders and in lane, these side stripes show up white and bright on dark asphalt pavements.

A new machine for laying asphalt curbs has been developed with which no forms of any kind are required. It molds a curb with a base of 8 inches and a height of 7¼ inches with rounded sides. A ton of hot plant-mix asphalt is required for each 55 lineal feet. Using two men to shovel asphalt into it, the machine travels at the rate of 10 feet per minute. In all, only five men are required for the operation. The machine saves both time and money and provides suitable asphalt curbs for laying out parking areas, channelizing islands, directing traffic, and other uses.

In the little town of Carver, Mass., residents believe they have the first divided highway ever built in the United States. Back in 1861 William Savery, in order to relieve local unemployment, built a road known as Savery's Avenue, which he later gave to the town. The road was a half-mile long and shaded with trees on either side. Down the middle was a dividing strip, also planted with trees and shrubs. In 1861 the road wasn't paved; but it is now—with asphalt. Asphalt covers over 4/5ths of all paved roads and streets in the United States.

In Idaho new highways often are given a light asphalt surface treatment that provides motorists with a dustless, mudless surface pending construction of asphalt pavement. The highway department has put up roadside signs explaining this stage construction procedure to motorists and advising them of the temporary surface treatment. Later, crews come along with their equipment and place the final heavy-duty asphalt wearing course.

The Garden State Parkway (nearing completion in this view) traverses New Jersey's coastal resort area. Note variable widths of right-of-way and medial zone.

New Jersey has a brand-new, asphalt-paved superhighway

THE GARDEN STATE PARKWAY

by Herbert Spencer, *Division Engineer, The Asphalt Institute*

Of the many factors which must be considered in planning any new highway, the matter of public convenience stands foremost. Will the highway serve the public well? Will enough motorists use it to justify its construction? Will it eliminate present traffic bottlenecks? These questions are discussed not only locally but also at the national level where the need for an adequate highway system has lately been receiving top recognition.

Situations similar to the one which existed in New Jersey, for example, are common in many areas throughout the United States. New Jersey had a congestion problem, a big one. Part of it was caused by the tremendous amount of interstate vehicular traffic clogging inadequate "corridor" highways in the State while moving to and from States to the north and those to the south and west. This necessitated construction of the famed New Jersey Turnpike, which now carries the bulk of this through traffic.

INTRASTATE TRAFFIC CONGESTION

Although the Turnpike solved the *interstate* phase of the congestion problem, there still remained the very bad bottlenecks and snarls which had long plagued the northern metropolitan area of the State. Here, through a band 3½ miles wide having no continuous north-and-south highways, passes through traffic amounting to approximately 300,000 vehicles per day. One-third of the total population of New Jersey, or about 1,350,000 people, lives within this area. The virtual strangulation of *intrastate* traffic movement was not only blighting the prosperity of the cities but was also greatly hindering motor vehicle access to the State's huge recreational area along the Atlantic Coast.

Due to the geographical location of this particular part of the Atlantic Seaboard, the principal direction of traffic is north and south, or west, with no opportunity for expansion to the east (see map on page 2). South of the Raritan River the existing state highways were totally inadequate to handle the volume of resort-bound traffic that funnelled in from the north, with the result that congestion was unusually intense, particularly at the Raritan River crossing.

Attempts were made at various times to effect a solution, mainly through widening of existing highways. This offered some relief but, as traffic continued to increase, it was realized that more drastic steps would have to be taken to eliminate the congestion. The answer to this part of the State's problem was construction of the Garden State Parkway, 143 miles of which have recently been opened, to handle the north- and southbound traffic within the congested section in the north and to provide an outlet for the millions of motorists travelling to the coastal resort area.

HIGHWAY AUTHORITY CREATED

Originally conceived as part of the State Highway system, the entire Parkway was to be built and financed with funds from road-user taxes and Federal Aid. The first section, a ten-mile stretch from Cranford in Union County to Woodbridge in Middlesex County north of the Raritan River, was opened to traffic in 1950. Subsequently, two shorter sections, totalling seven miles, were completed further south. The high cost of these sections, however, for which money was appropriated from the all-too-meager State Highway funds, together with the elapsed time of construction, convinced the State that between thirty and forty years would be required to complete the Parkway and that some other means of financing must be adopted. With traffic still on the increase, the result was that in 1952 the New Jersey legislature created the New Jersey Highway Authority for the purpose of finding a way to relieve the continuing congestion.

The Authority decided upon a highway, designated as the

Left: **The Parkway also passes through State's northern metropolitan area, taking both northbound and southbound traffic off congested city streets. White lines show Parkway route through Irvington, New Jersey.** ***Below:*** **Excavating and bulkheading operations in Irvington. Here Parkway passes under entire city block.**

Garden State Parkway, to extend from Paterson in the north to Cape May in the southernmost part of the State, a distance of 165 miles. Excluding the approximately twenty miles constructed by the State, this meant building some 145 miles plus an extension to be built later to the New York State line connecting with the New York Thruway.

The usual traffic and revenue studies definitely indicated that a toll road was justified, and the act creating the Authority empowered the financing of the project through a bond issue, guaranteed by the State, which the voters overwhelmingly approved at the November, 1952, election. The bond issue was set at $285,000,000, since increased to $292,000,000 to cover rising costs and the extension north to the New York State line. The Governor appointed three public-spirited citizens to serve as Members of the Authority, and in turn Mr. Harold Giffin was designated as Chief Engineer and the firm of Parsons, Brinckerhoff, Hall and MacDonald as General Engineering Consultants.

TRAFFIC

To determine the route of a project the size of the Garden State Parkway, as well as the location of interchanges, it is first necessary to make extensive traffic studies. In addition to analysis of potential traffic, the saving in driving time to be effected by the Parkway was given close study. By existing routes, the time for the 126.2-mile trip between Paterson, the northern terminus, and Atlantic City was determined to be three hours and fifty-four minutes—an average speed of 32.3 miles per hour. Traveling on the Parkway at 60 miles per hour—the speed limit—the same mileage can now be covered in two hours and six minutes, a time saving of approximately 46%. The Authority estimates that 52,833,000 vehicles will use the Parkway in 1955 alone, including 30,583,000 toll-payers expected to yield $12,003,000 in revenue.

The essential difference between a Parkway and a Turnpike is that truck traffic is curtailed on the former while all types of motor vehicles are permitted on the latter. On the Garden State Parkway trucks are allowed to travel from Cape May to a point in the vicinity of Lakewood, a distance of about 95 miles; north of here traffic is limited to buses and passenger cars only. When all work on the Parkway is completed there will be 82 interchanges consisting of 114 entrance ramps and 112 exit ramps. There will be twelve toll stations—eight of the barrier type across the Parkway and four entrance toll plazas. This means free entrance and exit privileges to all but four interchanges, with tolls charged for through travel.

PRESERVING THE SCENIC BEAUTY

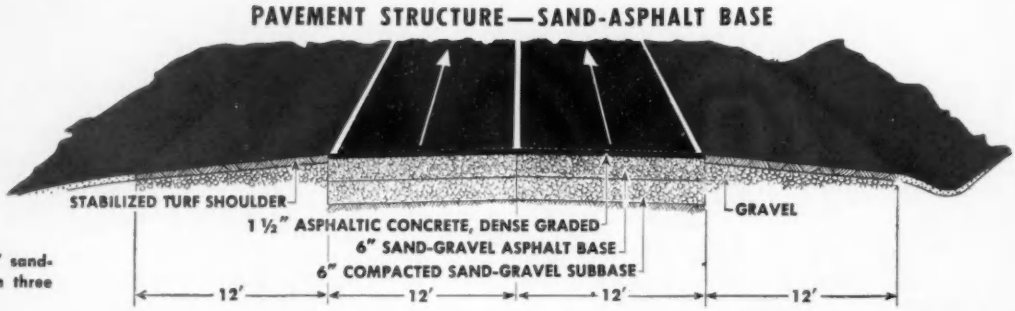
Every effort has been made to build beauty, as well as utility and safety, into the Garden State Parkway. During the early stages of construction special care was taken to protect from destruction by heavy equipment such existing landscape features as streams, rivers, woodlands and open meadows having scenic value to the motorist. Much of this is included within the right-of-way. Where the Parkway traverses rural areas, the right-of-way is generally 600 feet wide, increasing to 700-800 feet at small stream crossings or at points where the Parkway parallels a stream. In the built-up urban areas the right-of-way has a minimum width of 200 feet and, where there are marginal roads, a maximum of 300 feet.

Engineers gave careful study to the topography along the Parkway route. By using contour grading plans and varying slope design standards according to height of slope, it was possible to attractively fit the north- and southbound roadways, each studied separately, into the existing countryside, thus reducing cuts and fills to a minimum.

Another special feature of the Parkway is the section extending from Asbury Park to south of the Raritan River, where the design calls for a third roadway within the medial zone. This center roadway, when completed, will consist

Grading and compacting operations on Parkway slope prior to fertilizing, seeding and mulching. Hay mulch is tied down with cutback asphalt.

Photos: New Jersey Highway Authority



Finishing machines apply 6" sand-asphalt base course, laid in three 2" lifts.

of two twelve-foot lanes and will be reversible at times of peak traffic flow to and from the shore resorts. Many of the bridge structures and some of the grading for this roadway have already been constructed as part of the initial work.

For landscaping, all good topsoil was stripped and stockpiled and then used for covering areas to be seeded and fertilized. Wet excavation high in organic matter was employed to improve the sandy soils in the Jersey Pine, or barren, section of the State. Over 3,500 acres in the right-of-way were fertilized, limed, seeded, and mulched. Mulching was accomplished by blowing approximately two tons of hay on each acre and then anchoring it with a spray application of rapid-curing cutback asphalt (RC-2).

THE PARKWAY DESIGN

Before discussing the actual pavement design of the Garden State Parkway, it is necessary to point out some of the physical features of that part of the State of New Jersey through which the Parkway runs.

Engineers must rely on the results of borings to enable them to evaluate what is beneath the surface and to design accordingly. The many borings made along the line of the Parkway revealed the sub-surface structure—glacial deposits in the north and sands of the coastal plain in the south, all suitable for highway construction. In some cases, particularly where heavy cuts were to be made, areas of silty soils were encountered requiring special treatment, such as added base material, undercutting and special underdrainage. In the swampy areas near Cheesequake Park, for example, and also on a 4-mile section south of the Parkway bridge over the Mullica River, the method of sand-drains, used so successfully on the New Jersey Turnpike, was employed (see Asphalt Institute Quarterly, issue of October, 1951). The marshlands between the towns of New Gretna and Absecon, on the other hand, have a firm sandy base fifteen to thirty-five feet below the surface. In this area huge suction dredges excavated the muck for a width of 270 feet, and ocean sand was then pumped in for the Parkway foundation.

The Parkway design was varied to take advantage of these different conditions, resulting in the following three types of base construction (from south to north):

1. 6" Sand-Asphalt base (92 miles)
2. 5" Penetration Macadam base (32 miles)
3. 7½" Dry-bound Macadam base (21 miles)

Each type of base is overlaid with a wearing course of dense-graded asphaltic concrete.

THE SAND-ASPHALT BASE

South of the Raritan River to Cape May the Parkway passes through a coastal area consisting of sand and gravel available in unlimited quantities at practically no cost. In many sections of the United States sand-gravel in combination with asphalt has had outstanding success, particularly on Cape Cod, on Long Island, along the Atlantic seaboard from Virginia south, and in Florida.

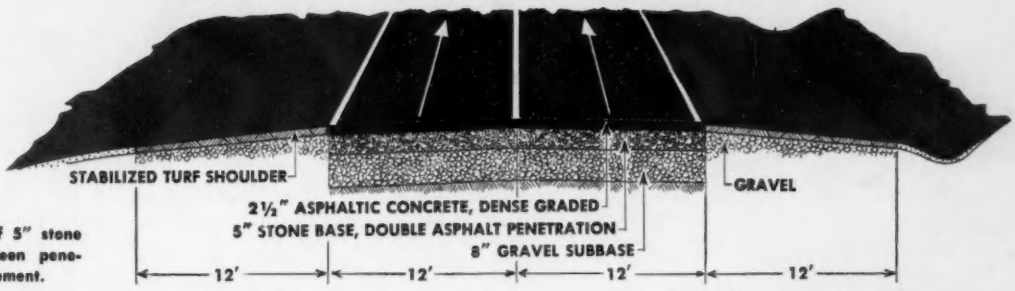
The Asphalt Institute, over a long period of years, has consistently advocated the use of suitable sands, gravels, and other granular materials in combination with asphalt for highway construction. Contrary to a rather old popular belief, *base* construction under a highway does not require the same quality tests on the aggregate that the top wearing course does, and engineers all over the United States are fast realizing this. The combination of asphalt with most granular materials has proven satisfactory for base construction provided a dense and durable type of asphaltic concrete is used for the wearing course.

For the Parkway, engineers subjected the sand-gravel mix to a multitude of laboratory tests, and careful study was made of the most suitable gradation, the load support value, the resistance to displacement, and the optimum quantity of asphalt required to obtain maximum stability. All of these tests met the exacting requirements of the Chief Engineer, and the design was prepared by the eminent Consulting Engineer firms engaged by the Parkway Authority to supervise the work.

To secure a comparison of cost between the sand-asphalt mix and a stone base with a dense-graded asphalt overlay, it was decided to call for bids on an alternate basis. The

Rolling 6" sand-asphalt base before applying 1½" wearing course of hot-mix asphaltic concrete.

PAVEMENT STRUCTURE — ASPHALT PENETRATION STONE BASE



Spreading second course of 5" stone base. First course has been penetrated with hot asphalt cement.

story the bids told was not surprising. As stone was available only by a long truck haul at excessive cost, no contractor bid on the stone base—every one of the bids for the approximately 92 miles was submitted on the sand-asphalt mix only. For this base the average bid price was approximately $1.80 per square yard, with an additional $.90 per square yard for the 1½" wearing course—a total of approximately $2.70 per square yard for 7½" of pavement structure. This means a total cost of approximately $76,000 per mile for *four* lanes of base and wearing course on this section of high-speed, heavy-duty highway. Such construction economy is possible only with asphalt and its unique ability, in combination with local materials, to provide a satisfactory pavement.

The sand-asphalt base was originally designed for a 3" bottom course of road-mix, using either a cutback asphalt or emulsion, and a 3" top course of hot plant-mix with the same sand-gravel aggregate. Placing road-mix is essentially warm-weather construction, however, and, in building the Parkway, the time element made it necessary for the engineers to alter their specifications and authorize the contractors to extend the hot plant-mix asphalt the full 6" depth of the base.

Thus it was possible to begin work on the sand-asphalt section in March, 1954, usually a cold-weather month on this part of the Atlantic Seaboard. Employing the most modern machinery available, including asphalt plants of the batch type and many of the continuous-mix type, with output of mixture averaging, in some cases, 200 tons per hour, the contractors were able to complete paving operations to permit unbroken travel, as of October 6, 1954, for 143 miles between Irvington and Cape May. This remarkably speedy construction is one of the many advantages of paving with asphalt.

THE ASPHALT PENETRATION STONE BASE

Section #7 of the Parkway, approximately thirty-two miles long and extending from the Raritan River Bridge to a point in the vicinity of Lakewood, includes areas of silty soils and black clays requiring special treatment. For this section a substantial gravel subbase, 8" in thickness, was specified, on top of which was placed 5" of stone in two courses, each course penetrated with hot asphalt. This penetrated stone base prevents the upward action of water from soils in this area and was much favored by the contractors, as it enabled them to finish construction much more quickly than would have been the case with a drybound stone base with screenings as a filler. For the wearing course 2½" of dense-graded hot plant-mix asphaltic concrete were placed.

THE FLEXIBLE STONE BASE

For the northern part of the Garden State Parkway, not yet finished, a flexible stone base 7½" in depth was specified, using screenings for the filler material. Power-driven vibrating tampers forced the filler into the voids. The stone base was further consolidated by heavy rollers and then primed with a coating of MC-1 cutback asphalt. The wearing course consists of 2½" of hot plant-mix asphaltic concrete having the same texture as that placed on the sand-asphalt base and on the asphalt penetration stone base. In other words, the asphalt wearing course, except for its thickness, is uniform throughout the entire length of the Parkway. The surface in this section is now nearing completion, with opening to traffic expected early in 1955.

The three types of based described above were selected to insure both economy and durability. The ample supplies of sand and gravel in the south and trap rock in the north enabled engineers to build, using these local materials in combination with asphalt, a heavy-duty pavement at low cost which is suitable for all kinds of traffic.

BUILT-IN SAFETY

The safety of the motorist was one of the prime considerations of all those concerned with design and construction of the Garden State Parkway. The high geometric design standards, the wide medial zone between opposing traffic lanes, the wide shoulders, flat slopes, shallow swale drainageways, and landscape treatment to relieve driver fatigue—all these features, together with the rugged, durable, smooth and dependable heavy-duty asphalt pavement, combine to make this $292,000,000 Parkway a traffic facility offering the maximum in safe, comfortable and pleasurable motoring.

Applying cutback asphalt prime coat to top of 7½" flexible stone base, in preparation for 2½" asphaltic concrete wearing course.

Condition of concrete pavement before rehabilitation.

Twenty-two mile section of Pennsylvania Turnpike now has a smooth, rugged asphalt surface.

ASPHALT RESURFACES TWENTY-TWO MILES OF WORN CONCRETE ON PENNSYLVANIA TURNPIKE

by Donald D. Dagler, *District Engineer, The Asphalt Institute*

For salvaging worn out concrete highways, asphalt has no equal. Surfaces which once seemed beyond repair, or were too costly to maintain, are given a new lease on life—cracks and bumps disappear under a carpet of smooth and rugged asphalt, placed at low cost with minimum inconvenience to the motorist and affording him safe, comfortable driving.

Such has been the case on the 327-mile Pennsylvania Turnpike, where 22 miles of portland cement concrete pavement have recently been resurfaced with asphalt. Increasing maintenance costs and the worn condition of the pavement brought about this necessary rehabilitation.

SEVERE SCALING AND CRACKING

The original 160-mile section of the Turnpike was just fourteen years old in October, 1954, having been opened to traffic in 1940. It consists of two twelve-foot traffic lanes in each direction of travel, separated by a ten-foot median strip. In the mountainous regions, where alternate freezing and thawing conditions have caused severe scaling of the concrete, maintenance costs have been especially high. Traffic loads also have cracked the pavement badly in many places. Repairing the road has been accomplished by removing the concrete slabs and replacing them with new slabs, a costly operation.

Rotor machine removes joint material before placement of asphalt overlay.

Continuous-mix and batch plants produce asphalt binder material

Placing and rolling 2" asphalt course.

Two more views of scaled and cracked concrete pavement prior to resurfacing with asphalt.

On July 1, 1954, the Pennsylvania Turnpike Commission accepted bids for resurfacing with hot-mix asphaltic concrete a section between the Laurel Hill and the Allegheny Tunnels, a distance of 22 miles. The Latrobe Construction Company submitted the low bid of $1,045,106.00 for 633,405 square yards of construction, not including the work to be done on the median strip and shoulders after laying the asphalt pavement. This Company, to which the contract was awarded, requested permission to subcontract the production and placing of the wearing surface material to the Allegheny Asphalt and Paving Company. The request was granted and the Turnpike Commission ordered work to proceed on July 21, 1954.

INITIAL PREPARATIONS

Two-way traffic was maintained on one side of the median strip while resurfacing operations were carried out on the opposite side. Before laying the new surface, however, it was first necessary to clean the concrete pavement. A wire power broom was employed to brush excess scale off the pavement while a rotor machine removed excess joint material from joints and cracks to a depth of approximately 1/8" to 1/4" below the pavement surface. Although the pavement had been mud-jacked, the engineers encountered pumping joints and some floating slabs. Subsealing with asphalt, a procedure recommended by the Asphalt Institute, was not carried out.

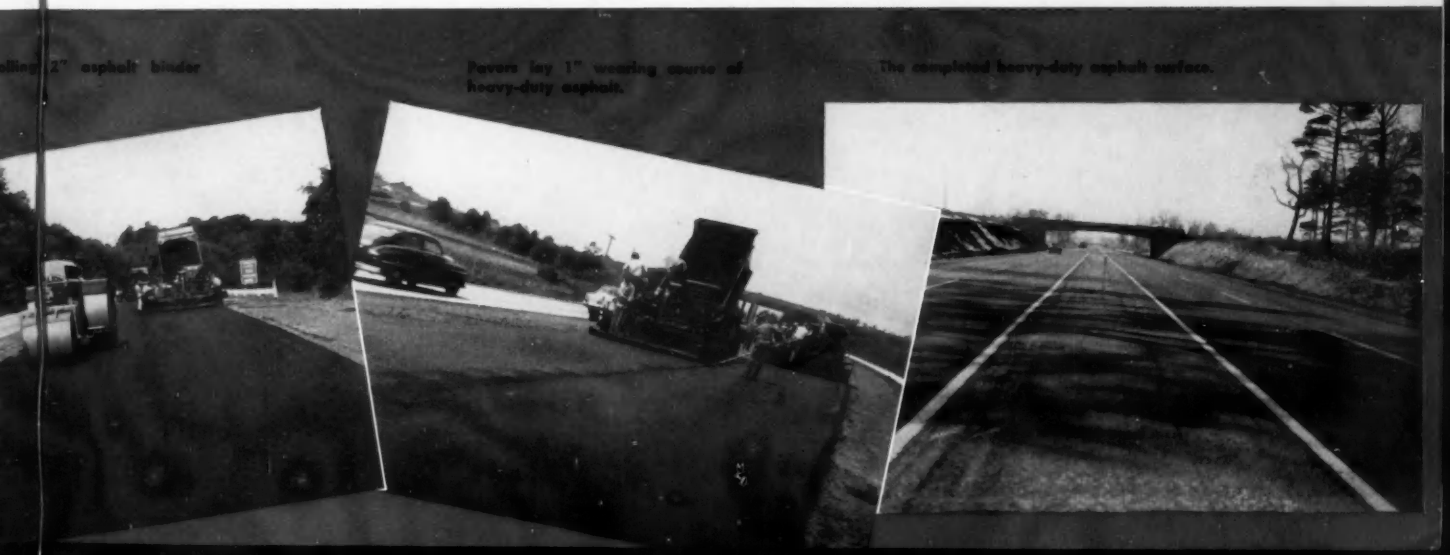
ASPHALT RESURFACING OPERATIONS

A continuous-mix plant and a batch plant produced the asphalt binder material, with output averaging approximately 1,800 tons per fourteen-hour day. Limestone coarse and fine aggregate were used with a 70-80 penetration asphalt. After two mechanical pavers working in tandem had placed the 2" binder course, it was compacted by three twelve-ton, three-wheel rollers and two twelve-ton tandem rollers.

Wearing surface material consisting of slag coarse and fine aggregate with 70-80 penetration asphalt was produced by one plant, using two driers, with an average daily production of 850 tons in a ten-hour day. The mixture was placed to a compacted depth of 1" by two mechanical pavers.

IDEAL SALVAGE MATERIAL

Completed on October 16, 1954, this resurfacing project is but another example of the suitability of asphalt for putting worn concrete highways in adequate service condition. The mileage of these highways, which have thus been rehabilitated, runs into the thousands, and there are many more miles which now need, or will require in the near future, renewal with a carpet of heavy-duty asphalt. The validity of using asphalt—and asphalt alone—for this type of construction is recognized by engineers everywhere.



Pavers lay 1" wearing course of heavy-duty asphalt.

LIQUID ASPHALTIC MATERIALS
EMULSIFIED ASPHALTS

by John M. Griffith
Engineer of Research

Fourth in the Series "Asphalt as a Material"

Emulsified Asphalt, mixed with slag, is laid by motor paver on Florida road.

In the preceding article of this series (Asphalt Institute Quarterly, April, 1954), Liquid Asphaltic Materials containing petroleum diluents were discussed (cutback asphalts and road oils). This article pertains to the other important class of these liquid materials—Emulsified Asphalts.

Emulsified Asphalts consist of minute globules of asphalt suspended in chemically-treated water. The asphalt globules are extremely small, generally in the colloidal size range. Asphalt-water emulsions are usually prepared in a high-speed mixing apparatus which emulsifies the asphalt into the water. The chemical used in treating the water is usually some type of caustic soap, clay, or other such agent which assists in promoting the emulsification process and which also controls some of the properties of the emulsion.

When the emulsion is deposited upon the surfaces of soil or stone, the asphalt particles coalesce through chemical action on the surface of the stone or by evaporation of the water. In the jargon of the trade, the emulsion "breaks" and in so doing leaves a thin film of asphalt on the aggregate.

TYPES AND GRADES

There are three standard types of Emulsified Asphalt and many specialty products made for specific applications. The three standard types are: Rapid Setting (RS), Medium Setting (MS), and Slow Setting (SS). The names given to these types indicate approximately the relative rates at which coalescence of the asphalt particles may be expected. In modern usage, however, it is more accurate to think of the RS grades as breaking on contact with stone, MS grades breaking on mixing with fine aggregates or prolonged mixing with coarse aggregates, and SS grades being capable of prolonged mixing with even fine aggregates and breaking only on final evaporation of the water from the mix. These properties are controlled principally by the amount and type of emulsifying agent used in the manufacture of the product.

Each type of Emulsified Asphalt is available in one or more standard "grades," varying either in viscosity of the Emulsified Asphalt or in consistency (penetration) of the asphalt cement used in preparing the Emulsified Asphalt. Grades which have been standardized by The Asphalt Institute are: RS-1, RS-2, MS-2 and SS-1. In general, the higher grade numbers indicate materials of higher viscosity or lower consistency of asphalt cement, or a combination of these two factors.

TESTS

For practical application of Emulsified Asphalts, the user requires certain specific characteristics. These are measured by standard tests, with limiting values for each prescribed by specifications.

Viscosity. The grade of any specific type of Emulsified Asphalt is determined basically by the *Saybolt Furol Viscosity Test*, which is also used to determine the viscosity of cutback asphalts and road oils. As this test procedure was discussed in the article on cutback asphalts and road oils, it is not repeated here.

Residue by Distillation. Important to the user are the amount and properties of the asphalt contained in the emulsion. The *distillation test* determines the proportional amounts of asphalt and water and provides an asphalt residue which may be subjected to further tests.

The distillation test is similar in general principle to that run on cutback asphalts and road oils, discussed in the preceding article, although the equipment and procedures are different. All details for this test are fully prescribed in ASTM Designation D 244.

Settlement. The *settlement test* detects the tendency of asphalt globules to settle during storage of an Emulsified Asphalt. It provides the user an element of protection against coarsely dispersed or internally unstable products. A sample of Emulsified Asphalt is allowed to stand in a graduated

Left: Road-mixing equipment blends Emulsified Asphalt with native sand. graders aerating mix prior to spreading. **Right: M**

cylinder for a period of five days, after which the difference in asphalt content between the top and bottom of the sample is determined. The procedure and equipment are fully prescribed in ASTM Designation D 244.

Sieve Test. The *sieve test* complements the settlement test and has a somewhat similar purpose. It is used to determine quantitatively the percent of asphalt present in the form of relatively large globules. Such globules do not provide thin and uniform coatings of asphalt on the aggregrate particles and may or may not be detected by the settlement test, which is of value in this regard only when there is a sufficient difference in the specific gravity of the asphalt and water to allow settlement to occur.

In the sieve test, a representative sample of Emulsified Asphalt is poured through a 20-mesh sieve. The sieve and retained asphalt are then rinsed with a mild sodium oleate solution and finally with distilled water. After rinsing, the sieve and asphalt are dried in an oven and the amount of retained asphalt determined.

Demulsibility Test. The *demulsibility test* indicates the relative rate at which the colloidal asphalt globules will coalesce (or "break") when spread in thin films on soil or stone. Calcium chloride will coagulate or flocculate the minute asphalt globules present in Emulsified Asphalts. In the test, Calcium Chloride and water are thoroughly mixed with Emulsified Asphalt and poured over a sieve to determine the degree of coalescence of the asphalt globules.

In testing Rapid Setting emulsions, a very weak solution of Calcium Chloride and water is employed; specifications prescribe the minimum amount of asphalt to be retained on the sieve. A high degree of "demulsibility" is required with this type of Emulsified Asphalt as it is expected to "break" almost immediately upon contact with the aggregates on which it will be applied.

The testing of Medium Setting Emulsified Asphalt requires a stronger solution of Calcium Chloride than that used in testing Rapid Setting types. In applications where the MS type is specified, rapid coalescence of the asphalt is not desired and specifications normally place a maximum limit on "demulsibility" for these products.

Cement Mixing Test. The Slow Setting type of Emulsified Asphalt, often employed with fine materials and dusty aggregates, must be substantially immune to rapid coalescence of the asphalt particles. A *cement mixing test* is therefore used in place of the demulsibility test for this type. The Emulsified Asphalt is mixed with a fine-ground portland cement and the mixture washed over an 80-mesh sieve. Specifications limit the maximum amount that may be retained on the sieve.

Tests on Residue. Since the water evaporates in service from the Emulsified Asphalt and leaves only the asphaltic residue, the properties of this residue are important to the user. Derived from the distillation test, the asphaltic residue is subjected to some of the usual tests for asphalt cements, normally only the penetration, solubility and ductility tests. These tests and their significance were discussed in the second article of this series (Asphalt Institute Quarterly, October, 1953).

USES

Emulsified Asphalts are used in ever-increasing quantities, both in the road construction field and in many specialty applications. The Rapid Setting Types, for example, have an important place in the construction of asphalt penetration macadam and in seal coating and surface treatment operations. The Medium Setting Type is used in road and plant mixes with coarse aggregate and in patching mixes. Slow Setting Emulsified Asphalts are often employed in fine aggregate or soil mixes. Specialty emulsion applications include roofing, floor mastics, paper sizing, undercoating of automobiles, crack sealing, and many others.

New and noteworthy applications are continually being devised for this versatile asphalt product. In recent years a number of highway organizations have initiated the use of a dilute Emulsified Asphalt base treatment and prime, placed in one or more applications. Construction practices vary, using either MS or SS grades of varying degrees of dilution, with or without blade mixing. This type of treatment has proven to be highly satisfactory in "setting up" the base prior to the construction of the asphalt pavement surface, and it is of particular benefit where traffic must be maintained during construction operations. A similar operation has been found to be quite economical and highly satisfactory for unpaved, residential streets. A particular advantage is the simplicity of equipment required. The mixture is prepared by partly filling a storage tank with water, adding the Emulsified Asphalt and then finally filling with water. Spraying the water into the tank under pressure satisfactorily accomplishes the mixing. The common water-sprinkling truck is suitable for application purposes.

Emulsified Asphalts are another important member of the versatile family of asphaltic materials. Available in wide variety at low cost, asphalt, in all its forms, is truly indispensable to the highway and industrial engineer.

Light Motor

Applying and mixing Emulsified Asphalt with local aggregate on West Virginia farm-to-market road.

Rapid Setting Emulsified Asphalt on penetration macadam pavement in Connecticut.

Rolling base course, prepared with dilute solution of Emulsified Asphalt, on Oregon road.

Apron paved with heavy-duty asphalt serves airport's new Terminal Building.

ASPHALT—the paving choice at San Francisco Airport

by C. J. Van Til, *Area Engineer, The Asphalt Institute*

The soaring popularity of commercial air travel since World War II has made necessary the improvement and expansion of airport facilities all over the world. Accommodation of millions of air passengers and increasing numbers of bigger, heavier aircraft has called for planning of the most intelligent sort by airport officials and engineers. And in case after case these planners have selected asphalt as the material best suited to fulfill their present and future paving requirements.

NEW TERMINAL BUILDING

At San Francisco's International Airport a beautiful new Terminal Building, designed to handle five million passengers a year, was dedicated on August 27, 1954. This represents a major milestone in the airport's history and reflects the phenomenal growth of air traffic in recent years. In the fiscal year 1940-41, 179,420 passengers flew in and out of this airport; in 1953 the count was over 2½ million. Officials are ready for even greater increases in passenger traffic, with provisions for enlarging the Terminal Building to enable accommodation of up to ten million people.

The present phase of enlargement and improvement of facilities had its major start in 1945 when a $20,000,000 bond issue was authorized. A second bond issue of $10,000,000 in 1949, and Federal Aid of about $5,300,000 made a total of approximately $35,300,000 available in the period 1945 to 1954.

ASPHALT PAVING SELECTED

During this phase asphalt was selected for nearly all paving. The airfield has four heavy-duty asphalt runways up to 8,870 feet long. Most taxiways, aprons and parking areas also have a rugged asphalt surface. The runway width is 200 feet with nine-foot crushed rock shoulders; taxiway pavements are 75 feet wide having five-foot shoulders of crushed rock surfaced with an asphalt seal coat. There are provisions for lengthening the present runways and adding two new ones should the need arise.

The entire landing field area has been constructed over former tidal marsh and bay bottom, the upper 30 to 80 feet of which consist of a soft, silty clay. Over this engineers placed 20 million cubic yards of select fill material—an ancient beach sand obtained from a pit 300 to 500 feet above sea level. The fill was built up in layers, each consolidated by tamping rollers and a 100-ton pneumatic-tire roller. This provided a firm foundation for the pavement structure.

PAVEMENT DESIGN

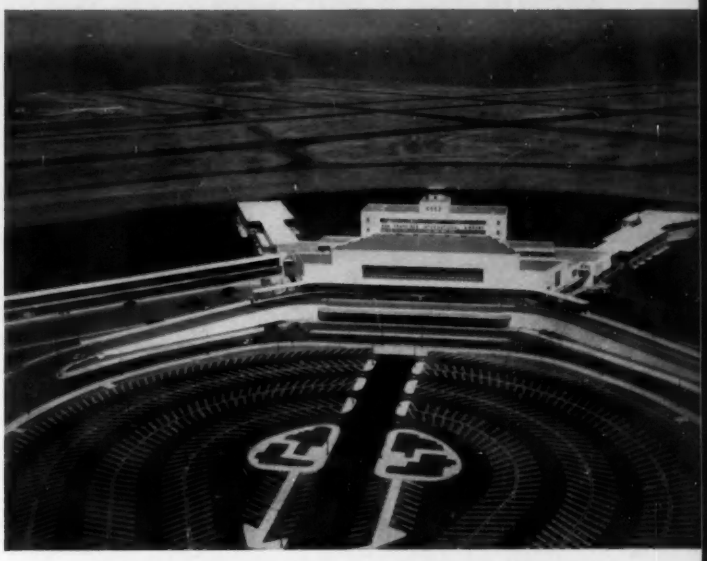
Airfield pavements at the San Francisco International Airport have been designed to support aircraft having 100,000-

pound wheel-loads, with tire pressures of 100 pounds per square inch. For taxiways, loading aprons and runway ends the latest design—and that intended for future similar construction—calls for 3½″ of asphaltic concrete surfacing, 10″ of crushed aggregate base and 4″ of crushed aggregate subbase. This design was employed in the recent construction of the large apron which services the new terminal building.

ASPHALT PARKING AREA

In addition to the pavements used by aircraft, the airport's automobile parking area and all access and service roads, amounting to over 50,000 square yards, are paved with asphalt. The present parking area will accommodate 4,400 automobiles exclusive of the passenger loading areas; space is available to increase this capacity when and if it becomes necessary.

With foresight and efficient planning, and by economical pavement construction with heavy-duty asphalt, officials and engineers have provided San Francisco with a fine air terminal designed to keep pace with the continually expanding commercial air industry for many years to come.



Asphalt parking area will accommodate 4,400 cars. Runways (in background), also asphalt-paved, are designed for 100,000-pound airplane wheel-loads.

Photo: Keith Cole Studios

ASPHALT INSTITUTE MOVIES

All Are Produced in Color and Sound

ASPHALT—THE MAGIC CARPET

Latest Institute film production. Tells non-technical story of advantages of asphalt pavement construction through medium of actual present-day American Town Meeting on Long Island. Laboratory demonstrations of asphalt's physical properties. An introduction to asphalt for the general public.

Length: 940 feet. Running time: 28 minutes.

THE NEW JERSEY TURNPIKE

Construction of this famed superhighway from foundation to finished asphalt pavement.

Length: 739 feet. Running time: 20 minutes.

HEAVY-DUTY HIGHWAYS WITH HOT-MIX ASPHALT

Heavy-duty asphalt highway construction in the U. S. Shows how materials are obtained and assembled, with complete asphalt plant operation.

Length: 865 feet. Running time: 24 minutes.

THE TURNER TURNPIKE

Procedures employed in constructing Oklahoma's 88-mile, heavy-duty asphalt toll highway.

Length: 875 feet. Running time: 25 minutes.

ASPHALT IN HYDRAULICS

How asphalt is used to pave and protect such hydraulic installations as dams and dikes, canals, reservoirs, jetties. Shows equipment and construction methods employed.

Length: 720 feet. Running time: 19 minutes.

There is a limited supply of these 16 millimeter films available for showing at clubs, conventions and in the engineering classroom. Inquire at your nearest Asphalt Institute Office (see list on next page) for details.

H. B. PULLAR

Chairman of the Executive Committee of The Asphalt Institute

H. B. Pullar, President of the Berry Asphalt Company, is serving as Chairman of the Executive Committee of The Asphalt Institute for 1955. Associated with the Institute continually since its organization in 1919, Mr. Pullar's long and varied career in the asphalt industry began in September, 1907. Through the years he has held important positions as highway engineer, chemist and executive, serving with and organizing various companies in the petroleum industry. He is a member of many technical and business associations, including the American Society of Civil Engineers, the Association of Asphalt Paving Technologists, and the American Society for Testing Materials.

ASPHALT IN ROAD-BUILDING—1955

by H. B. Pullar

With automobiles pouring from assembly lines in ever-increasing numbers and a great new highway-building program taking shape, asphalt, as 1955 begins, stands at the threshold of its greatest development. As the material best suited for all road-paving needs, its leadership in the highway construction field, already long established, is expected to become stronger than ever.

The outstanding record that asphalt has made as a road-paving material is one of which the entire petroleum industry can well be proud. It can be summed up in the single fact that over 4/5ths of all paved roads and streets in the United States have an asphalt surface. That's quite an achievement. Consider what would happen to American automotive transportation if all that asphalt mileage were suddenly removed. Traffic would almost cease to move. And consider further the effect on our economy if *that* were to happen!

That is how important asphalt is today—truly one of the key products of our modern way of life.

Tomorrow promises a highway construction program greater than this country has ever known. More and better roads and parking space is the continuing cry, and, it appears, American motorists are going to get them. The opportunities which this huge undertaking will offer to the numerous industries that benefit from road construction are tremendous indeed. Not the least of those to reap great rewards will be the petroleum industry, not only through the sale of its consumable products but also—and just as important—through the sale of its special engineering product—asphalt. New and finer highways allowing more vehicles to travel more miles mean greater consumption of motor fuels and lubricants.

With billions of dollars already committed to new highway construction, and far more to be spent in the foreseeable future, the petroleum industry and the Asphalt Institute through its members are assuming a vastly increased position of responsibility in the country's economical and industrial expansion, a role for which, based on past accomplishments, they are well prepared.

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